DIVING TANK POCKET BUOYANCY COMPENSATOR WITH ADJUSTABLE PRESSURE VALVE

BACKGROUND OF THE INVENTION

This invention relates to buoyancy controlling and compensating devices (BCDs) for divers to control their depth in diving waters and their return to surface, and more particularly, to a BCD that envelopes a diving tank rather than the diver.

Known prior diving chutes have had diver-attachment portions that are inflatable with low-pressure air that is valve-released from high-pressure air in a diving tank for providing buoyancy. Some of the diver-attachment portions are included in belt-like and suspender-like structure of the diving chutes. Others include back air cells for receiving the low-pressure air for buoyancy control.

None are known, however, to have one or more inflatable air cells with automatically controllable air volume in a diving-tank pocket which is attached to a diving tank and a diving-chute harness in a manner taught by this invention.

The known related prior art includes the following references:

U.S. Patent No.	Inventor	Issue Date
6,354,295	Hasson, Jr.	03-12-2002
5,902,073	Eungard, *et al.*	05-11-1999
4,752,263	Pritchard, *et al.*	06-21-1988
6,592,298	Beltrani	07-15-2003
4,016,616	Walters	04-12-1977
2,864,101	Kissenberger	12-16-1958
3,998,304	Edgerton, Jr., *et al.*	12-21-1976
5,267,815	Feder	12-07-1993
5,620,282	Stinton	04-15-1997
6,120,213	Stinton	09-19-2000
5,997,216	Kawashima	12-07-1999

SUMMARY OF THE INVENTION

Objects of patentable novelty and utility taught by this invention are to provide a diving-tank-pocket buoyancy compensator which:

does not obstruct bodily movement;

can be streamlined for low water resistance;

can be adjusted linearly in relationship to a diving chute on a user's body for neutral buoyancy and attitude balance that allows convenient attitude control with movement of the user's body;

can prevent over inflation by use of a novel pressure adjustment valve;

can be attached to a selection of styles, sizes and shapes of diving chutes; and

can be used for containing desired articles when the inflatable air cells are deflated.

This invention accomplishes these and other objectives with a diving-tank-pocket buoyancy compensator having an expandable diving-tank pocket that is articulated for containing a diving tank and at least one inflatable air cell. The buoyancy air cell is in fluid communication with a cell end of a buoyancy compensator (BC) tube which has a tank end in fluid communication with an inside periphery of a diving tank through a regulator tube in fluid communication with a regulator valve on the diving tank. An adjustable pressure valve intermediate the tank end and the cell end of the BC tube is provided to maintain a constant pressure and resulting constant volume of air in the buoyancy air cell for maintaining a desired constant buoyancy continuously following any change in air volume and pressure in the buoyancy air cell resulting from inlet of air through the BC tube and outlet of air

through a tube-outlet valve in the BC tube and/or through a cell-relief valve in the air cell. The expandable diving-tank pocket and the diving tank are attachable to a predetermined diving-chute harness with at least one tank strap by positioning a pocket-attachment portion of the diving-tank pocket snugly intermediate a chute-attachment portion of the diving-chute harness and a tank-attachment portion of the diving tank. The tank strap is preferably metallic and has a screw-threaded adjustment buckle.

The above and other objects, features and advantages of the present invention should become even more readily apparent to those skilled in the art upon a reading of the following detailed description in conjunction with the drawings wherein there is shown and described illustrative embodiments of the invention.

BRIEF DESCRIPTION OF DRAWINGS

This invention is described by appended claims in relation to description of a preferred embodiment with reference to the following drawings which are explained briefly as follows:

FIG. 1 is a partially cutaway side view of the expandable diving-tank-pocket buoyancy compensator attached to a diving chute harness and to a diving tank;

FIG. 2 is a section view taken through section line 1-1 of **FIG. 1**;

FIG. 3 is a front view of the **FIG. 1** illustration;

FIG. 4 is a partially cutaway side view of an adjustable pressure valve on a BC tube;

FIG. 5 is a partially cutaway side view of a side-mount pressure valve on the BC tube;

FIG. 6 is a bottom view of a twin air cell in a diving-tank-pocket attached to a diving chute harness and to a diving tank;

FIG. 7 is a partially cutaway side view of an adjustable pressure valve having a resilient sleeve for restricting water entry;

FIG. 8 is a partially cutaway side view of a side-mount adjustable pressure valve having the resilient sleeve for restricting water entry;

FIG. 9 is a partially cutaway top view of a tank strap in attachment relationship to a diving tank and a diving-tank pocket;

FIG. 10 is an end view of the diving-tank pocket that is usable as a diving bag independently of attachment to a diving tank and a diving chute;

FIG. 11 is a side view of an embodiment of the diving-tank pocket for use as a diving bag and having arcuate ends; and

FIG. 12 is a side view of an embodiment of the diving-tank pocket for use as a diving bag and having orthogonal ends.

DESCRIPTION OF PREFERRED EMBODIMENT

Listed numerically below with reference to the drawings are terms used to describe features of this invention. These terms and numbers assigned to them designate the same features throughout this description.

1. Diving-tank pocket/skin
2. Diving tank
3. Buoyancy air cell
4. Cell end
5. BC tube
6. Tank end
7. Regulator valve
8. Adjustable pressure valve
9. Inflation valve
10. Cell-outlet valve
11. Cell-relief valve
12. Diving-chute harness
13. Tank strap
14. Pocket-attachment portion
15. Chute-attachment portion
16. Tank-attachment portion
17. Pocket closer
18. Tank-top end
19. Tank-bottom end
20. Diving-adapted zipper
21. Control conveyance
22. Check valve
23. Adjustment spring
24. Adjustment knob
25. Overflow outlet
26. On-off switch
27. Air entry
28. Conical valve
29. Point portion
30. Valve seat
31. Conical shoulder portion
32. Envelope cell
33. Twin cells
34. Umbilical member
35. Regulator tube
36. Quick-release buckle
37. Tightness adjuster
38. Side-mount valve
39. Resilient sleeve
40. Bypass valve
41. Handle
42. End closer

Referring to **FIGS. 1-3**, a diving-tank-pocket buoyancy compensator (BC) has an outer diving-tank pocket or skin **(1)** that is articulated for containing at least a diving tank **(2)** and an inflatable buoyancy air cell **(3)**. The buoyancy air cell **(3)** is in fluid communication with a cell end **(4)** of a buoyancy compensator (BC) tube **(5)** which has a tank end **(6)** in fluid communication with an inside periphery of the diving tank **(2)** through a regulator valve **(7)** on the diving tank **(2)** and through a

regulator tube **(35)** in fluid communication intermediate the regulator valve **(7)** on the diving tank **(2)** and the cell end **(4)** on the BC tube **(5)**.

An adjustable pressure valve **(8)** intermediate the tank end **(6)** and the cell end **(4)** of the BC tube **(5)** is employed for maintaining a constant pressure and resulting constant volume of air in the buoyancy air cell **(3)** without overfill nor under-fill of the buoyancy air cell **(3)** and for thereby providing a desired constant buoyancy with volume of air in the buoyancy air cell **(3)**. This is accomplished by adjusting for any change in volume and pressure in the buoyancy air cell **(3)** that may result from intentional inlet of air through an inflation valve **(9)** in the BC tube **(5)** and outlet of air through a cell-outlet valve **(10)** in the BC tube **(5)** and outlet of air through a cell-relief valve **(11)** in the buoyancy air cell **(3)** selectively. Change in volume and pressure of air in the buoyancy air cell **(3)** requiring adjustment with the adjustable pressure valve **(8)** might also occur from possible minor valve and air-cell leakage.

The diving tank **(2)** is attachable to a predetermined diving-chute harness **(12)** with at least one tank strap **(13)**.

As shown in **FIGS. 1** and **9**, the expandable outer diving-tank pocket **(1)** can include a pocket-attachment portion **(14)** that is positioned intermediate a chute-attachment portion **(15)** of the diving-chute harness **(12)** and a tank-attachment portion **(16)** of the tank strap **(13)** for avoiding contact of the tank strap **(13)** with users.

The diving-tank pocket **(1)** can be closable with a pocket closer **(17)** intermediate a tank-top end **(18)** and tank-bottom end **(19)**. The pocket closer **(17)** can include a diving-adapted zipper **(20)**.

The diving-tank pocket **(1)** can include preferably a predeterminedly streamlined contour with the tank-top end **(18)** being predeterminedly arcuate.

The expandable diving-tank pocket **(1)** can include volumetric capacity for containing the buoyancy air cell **(3)** in an inflated mode in addition to containing the diving tank **(2)**. The diving-tank pocket **(1)** also can include volumetric capacity for additional storage space.

The tank strap **(13)** can include a metallic strap that has a predeterminedly quick-release buckle **(36)**. The tank strap **(13)** also can include a tightness adjuster **(37)** as shown in **FIG. 9**.

Referring to **FIGS. 4-5** and **7-8**, the adjustable pressure valve **(8)** includes a control conveyance **(21)** in fluid communication from the BC tube **(5)** to a check valve **(22)** that is adjustably spring-loaded with an adjustment spring **(23)** having tension adjustment with a screw-threaded adjustment knob **(24)** for allowing bypass of air selectively to an overflow outlet **(25)** for allowing excess air pressure to escape from the buoyancy air cell **(3)** controllably.

A water seal can be employed for restricting entry of water into the control conveyance **(21)** and thus into the BC tube **(5)**. The water seal can include a resilient sleeve **(39)** that is articulated and positioned on the overflow outlet **(25)** as shown in **FIGS. 7-8**, for being pressured in closing contact with the overflow outlet **(25)** from water pressure when overflow air is not escaping through the overflow outlet **(25)**.

An on-off switch **(26)** can be positioned in flow-control communication intermediate the control conveyance **(21)** and the overflow outlet **(25)** as shown in **FIG. 4**.

The check valve **(22)** of the adjustable pressure valve **(8)** is adjustable for preventing overfill of the buoyancy air cell **(3)** by adjusting spring pressure of the adjustment spring **(23)** for allowing escape of air through the overflow outlet **(25)** from pressure in excess of a maximum selected with the adjustment knob **(24)**.

The adjustable pressure valve can include a side-mount valve **(38)** which has the control conveyance **(21)** in fluid communication from the BC tube **(5)** and has a conical valve **(28)** having a point portion **(29)** of the conical valve **(28)** positioned cyclically in contact with a valve seat **(30)** for valved air flow to the overflow outlet **(25)** as regulated with pressure of the adjustment spring **(23)** for allowing opening of the conical valve **(28)**.

A water seal for restricting entry of water into the control conveyance **(21)** can be employed also for the side-mount valve **(38)**. As shown in **FIG. 8**, the water seal can include the resilient sleeve **(39)** that is articulated and positioned on the overflow outlet **(25)** for being pressured into closing contact with the overflow outlet **(25)** from water pressure when overflow air is not escaping through the overflow outlet **(25)**. Valve portions of the check valve **(22)** and of the side-mount valve **(38)** can be rubber or otherwise resiliency coated, as shown in **FIGS. 4-5**, to restrict entry of water when air is being released.

Connection means and tensile strength of the of the adjustable pressure valve **(8)** and for the side-mount valve **(38)** intermediate the cell end **(4)** and the tank end **(6)** of the BC tube **(5)** can be articulated with strength sufficient to allow jerking of any portion of the BC tube **(5)** for jerk-operation of an emergency-release valve proximate a BC-tube air entry **(27)** into the buoyancy air cell **(3)** for quick emergency dives to escape boat propellers and for other emergencies.

The diving-tank pocket **(1)** can include a generally cylindrical shape.

The diving-tank pocket **(1)** can include flexible structure with neoprene.

The buoyancy air cell **(3)** can include an envelope cell **(32)** that is wrapped onto the diving tank **(2)** as shown in **FIG. 2**.

Select forms of the buoyancy air cell **(3)** can be employed. As shown in **FIG. 6**, the buoyancy air cell **(3)** can include twin cells **(33)** that are positioned on opposite sides of the diving tank **(2)** and joined with an umbilical member **(34)** that is positioned adjacent to a predetermined portion of the diving tank **(2)**. The umbilical member **(34)** includes structure for air conveyance for balancing air pressure and volume in the twin cells **(33)** when adding air to or releasing air from the twin cells **(33)**.

As shown in **FIGS. 7-8**, a bypass valve **(40)** can be provided in the control conveyance **(21)** for allowing flow of air through the BC tube **(5)** without regulated escape through the adjustable pressure valve **(8)** selectively.

The side-mount valve **(38)** includes the control conveyance **(21)** in fluid communication from the BC tube **(5)** to the check valve **(22)** that is adjustably spring-loaded with the adjustment spring **(23)** having tension adjustment with the screw-threaded adjustment knob **(24)** for allowing bypass of air selectively to the overflow outlet **(25)**. The check valve **(22)** for the side-mount valve **(38)** includes a conical valve **(28)** having a point portion **(29)** of the conical valve **(28)** positioned cyclically in a valve seat **(30)** proximate the overflow outlet **(25)** with pressure of the adjustment spring **(23)** for closing the check valve **(22)** and having a conical shoulder portion **(31)** of the conical valve **(28)** exposed to air pressure from the control conveyance **(21)** for forcing the conical valve **(28)** against pressure of the adjustment spring **(23)** for opening the check valve **(22)**.

The expandable diving-tank pocket **(1)** can be arcuate at the tank-top end **(18)** and at the tank-bottom end **(19)** with an end closure **(42)** for use as a diving bag that is closable intermediate the tank-top end **(18)** and at the tank-bottom end **(19)** with the pocket closer **(17)**. At least one handle **(41)** can be affixed to a top side for

carrying the diving-tank pocket **(1)** and other diving gear independently of whether the diving tank **(2)** is attached internally to the diving-tank pocket **(1)**.

The diving-tank pocket **(1)** can be orthogonal at the tank-top end **(18)** with the end closer **(42)** and at the tank-bottom end **(19)** with the end closer **(42)** for use as a diving bag that is closable intermediate the tank-top end **(18)** and at the tank-bottom end **(19)** with the pocket closer **(17)** for allowing access to the regulator valve **(7)** and for resting a bottom of the diving tank **(2)** directly on a surface selectively.

A new and useful diving-tank-pocket buoyancy compensator having been described, all such foreseeable modifications, adaptations, substitutions of equivalents, mathematical possibilities of combinations of parts, pluralities of parts, applications and forms thereof as described by the following claims and not precluded by prior art are included in this invention.